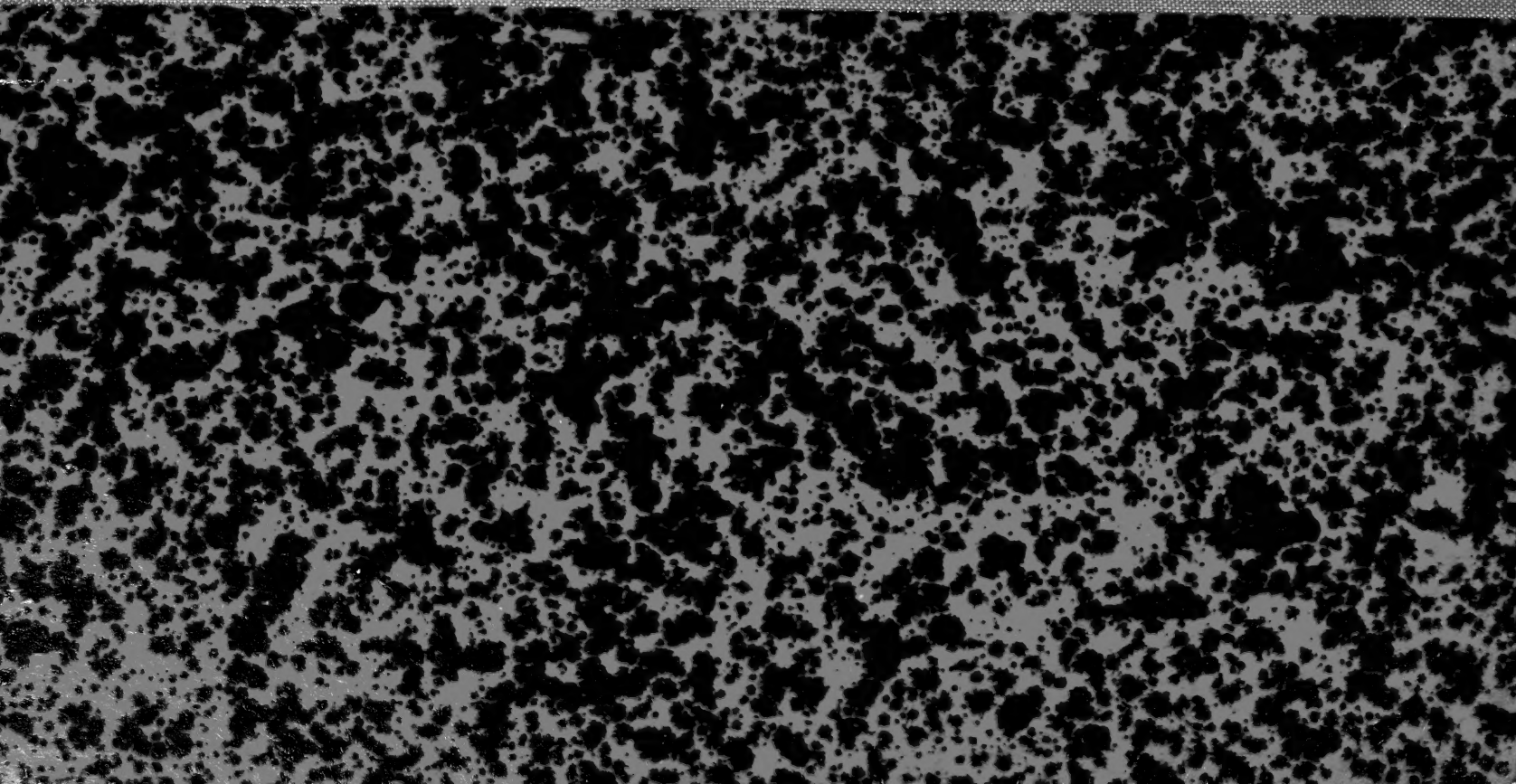
Cole, T. — Infusorial objects of Salem, Mass. (1853)



Professor A. Gray
with the regards of Mr. T. Cole

LIST

OF

INFUSORIAL OBJECTS,

FOUND CHIEFLY IN THE NEIGHBORHOOD OF

SALEM, MASSACHUSETTS;

WITH A SKETCH OF THE

PROGRESS OF THIS BRANCH OF

NATURAL HISTORY,

BY

THOMAS COLE, A.M., A.A.S.

MEMBER OF THE ESSEX INSTITUTE, &c.

[From the Proceedings of the Essex Institute.]

SALEM:

IVES & PEASE.....PRINTERS.

1853.

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INFUSORIA.

Nearly two centuries have passed away, since the microscope revealed to mankind a department of the animal kingdom, consisting of bodies imperceptible to the unassisted vision, but displaying, under the microscope, countless multitudes of active forms, so strange and various in their appearance, so beautiful, and withal so wonderful in their organization, that a general curiosity was excited to view this new page of nature's history, while the ingenuity and skill of the most learned were exhausted in forming vague theories, and absurd speculations, based upon the novel and interesting spectacle.

A slight sketch of the progress made in the investigation of this branch of natural history, for which the writer is chiefly indebted to Professor Ehrenberg's great work on the Infusoria, will not, it is hoped, be an inappropriate accompaniment to the following list of infusorial objects.

In April of the year 1765, while the atoms and whirlpools of Descartes were exciting the attention of the learned, Leeuwenhoek, an eminent physician of Delft, in Holland, who had busied himself with microscopical examinations of the structure of plants and of the nerves of animals, and who, by his skill in the construction of his microscopes, his ingenuity in the preparation of his subjects, and his method of applying them to the microscope, was eminently qualified to make these inquiries, discovered, in a drop of rain water, multitudes of briskly moving particles, and thought he had found the animated primordial atoms of

the world. Further observations upon their motions, and more especially, the discovery, in some of them, of motive organs, convinced him of their animal character, and he gave them the name of animalcules. In the course of his experiments, Leeuwenhoek had already made an infusion of pepper in water, with the hope of discovering the cause of its pungency: this, after a few weeks, he found swarming with animals. Others repeated the experiment, and as new forms were detected, new theories respecting them were advanced, varying with the activity of imagination in the observers. "This wonderfully great world of life," says Ehrenberg, "concealed from mankind, has, since its discovery, been often described, under the pen of easily moved and fantastical writers, as a monstrous spirit world, filled with forms of which the openly visible world affords no parallel, in part wonderfully, in part horribly distorted; neither actually living, nor actually lifeless. Others have derived them from the sportive wantonness of plastic nature; even so late as the year 1820, the power of charming, (*Zauberkraft*) with which some of these forms were supposed to be endued, was circumstantially described by an otherwise meritorious writer."*

An opinion early prevailed, that various diseases were caused by minute insects filling and polluting the air, and in the Philosophical Transactions of the British Royal Society for 1677, a writer gravely proposes to frighten and scatter these pestiferous armies by the noise of drums, trumpets, and cannon, especially he recommends the cheerful shouting of women and children for this purpose. Leeuwenhoek believed that mankind and all animals originated in spermatozoa. A French philosopher, Periault, defended the idea, derived, it is said, from Hippocrates, that nothing *begins* to exist, but that every thing is *present*, and is only developed and increased. Professor Sturm of

* Infusionsthierschen Vorrede, S. 6.

Altdorf, believed that the whole air was filled with little men and animals, countless numbers of which are inhaled and respired with every breath. Another eminent observer, Hartsoeker, maintained that the infusoria were the larvæ of invisible winged insects that filled the air, and he also imagined that the human race was developed from a single spermatozoon. It was the opinion of distinguished physicians in France, Italy and England, that the plague was produced by microscopic animalcules; and that the pestilence which raged in Marseilles in 1720, was to be ascribed to mite formed animalcules with crooked beaks and claws.

Opinions of this kind long prevailed, but at last their absurdity subjected them to ridicule and contempt, till they ceased to be the occasion of visionary theories. "Rash conclusions," says Ehrenberg, "frivolous disputes, ostentatious speculations of philosophical heads so called, imperfect instruments, and awkwardness and hurry in the use of such instruments as for that time were good, and more especially preconceived notions, were then, as now, for a long time a hindrance to the correct general application of the knowledge which had been collected and confirmed; and Leeuwenhoek continued, not less than forty years, to be considered as the only especially good observer."*

In the year 1746, Linnæus first communicated his views of the spermatozoa and infusoria. He considered them as lifeless, oily particles, and their movements as altogether passive. This opinion he afterwards abandoned, and assigned to a few of them a place among the polypi, mollusks, and lithophytes; but by far the greater number, he places in his last class, which, not inappropriately, he calls "Chaos," for in this class he brings together the eels of paste and vinegar, which he believed revived upon the application of moisture, after having been dried for years;

*Infusionsthierschen Vorrede, S. 8.

the seeds of fungi, which he describes, on the authority of Baron Munchausen, as at first living and moving, but as afterwards becoming fixed, and growing into fungi; the smut of grain, which, on the same authority, when macerated in water, becomes an oblong hyaline animalcule: lastly, in what he call his "Chaos Infusorium," he has swept together all other infusorial objects, to which he has added the contagion of fevers, the syphilitic virus, the spermatozoa, the septic power of putrefaction and fermentation, and even the cloudiness of the atmosphere in spring, all of which he ascribes to living molecules, and thinks they probably belong to this family.*

It is remarkable that Linnæus, with all his qualifications as a naturalist, upon these subjects, took his opinions upon the authority of others, as appears from his own account, without having made a single observation himself of the objects which he describes.

Examples of the imperfect observations, and rash conclusions respecting the infusoria, which prevailed among the learned of that day, need not be multiplied, and we pass to the next important advance in the developement of this branch of natural history. This was made by Otto Frederic Müller, a Danish Counsellor, in a series of observations published in 1773, and, more especially, in his posthumous work, published in 1786, in which he divides the infusoria into two classes, viz: those which have, and those which have not, visible external organs; the former he calls Bullaria, the latter Infusoria.‡ This was the first attempt to make a systematic classification of these objects according to certain characteristics in their form, and although the basis of this classification was uncertain, and the cause of much confusion, by bringing into the same class objects that in the most material points, were widely different, yet

* Linnæi Systema Naturæ, Vol. 1, Part 2, p. 1326.

‡ Muller Animalcula Infusoria, Præf. pp. 8, 28.

his method of sharply discriminating between individual forms, was successfully followed by various distinguished naturalists, and his systematic arrangement was the basis on which they rested their observations until the year 1830.

Although Müller deserves the high praise bestowed upon him by Prof. Ehrenberg, for his generally sound philosophical views, his ardent desire to discover the truth rather than to promote a favorite hypothesis, and the severe examination to which he subjected his own opinions, yet even he did not wholly escape the errors of the times: in the preface to his posthumous work, he says, that animal and vegetable substances, are, by decomposition, resolved into vesicular pellicles, which vesicles, or globules, like the crystalline globules of fungi, extend over objects in a series, and form a web like that of a spider. These globules, gradually released from the common mass, revive, and become infusorial and spermatic animalcules, and from these, every kind of animal and vegetable form appears to be produced.*

Of the difficulties he had to encounter in prosecuting this novel course of inquiry, he thus speaks: The difficulties under which the investigation of microscopical animals labors, are innumerable, and the certain and distinct resolution of them, requires so much time, such sharpness of vision, and such acuteness of judgment, the presence of so much patience and mental composure, that nothing can surpass it. Nothing is easier than to *see* animalcules, and to be delighted with their movements and sport, but to perceive the differences in these most simple, active and mutable little animals, in the smallest area, illuminated with very few rays of light, and every moment escaping from the view, and to describe in suitable language these perceptions, and the various motions of each one,—'hic labor, hoc opus.' Hence after the lucubrations of many hours, when I have become weary of seeing and admiring,

* Animalcula Infusoria, Præf. p. 24.

from the deficiency of words expressive of these unusual motions and images, and from fear lest those things which I had perceived both with the eye and the mind, should remain obscure to the reader, I have committed nothing to paper.*

Many distinguished naturalists followed the course of investigation which Müller had successfully pursued, and almost all of them drew their materials from the storehouse of his observations, and as they took their facts from him, so also they adopted his speculative opinions. Accordingly we find the doctrine of simplification in the organization both of the animal and vegetable kingdoms very generally supported, and even carried to the extreme of denying the existence of all organization in some classes of infusoria; and in connection with this doctrine, the theory of spontaneous generation, or the primary existence of organic animal and vegetable forms from inorganic matter, was also maintained. Among those, who have advocated the doctrine of a gradual developement of organisms from inorganic molecules up to the highest and most complex organization in the animal and vegetable kingdoms, Lamarck and Oken are conspicuous; the former held to the gradual developement of animals as the circumstances of their condition might require; the latter considered the ocean as the great storehouse whence terrestrial animals and vegetables, a little metamorphosed to suit them to their terrene state, were derived.

To test this doctrine of a spontaneous generation, Prof. Ehrenberg, in 1816, commenced a series of observations on fungi, infusoria, and entozoa, objects that seemed more especially to favor this hypothesis. In 1819, he obtained a direct and satisfactory proof of the existence of a germ in every seed of fungus and mucor, and from the mass of seed, which was present, the origin of those plants, from spon-

* Animalcula Infusoria, Præf. p. 18.

taneous generation, was rendered, as he says, extremely improbable and unnecessary. Subsequently, in various extensive journeys, accomplished under royal patronage, one of which, into Africa, was protracted into a residence of six years, he obtained opportunities of comparing the infusorial forms, found in different regions of the globe, and in 1830, he communicated his observations to the Berlin Academy. Continuing these researches, in which he had become deeply interested, he discovered that the silicious remains of one class of these objects, the Bacillariæ, enter into the composition of bog iron ore, are imbedded in flints, and constitute large strata of the earth's surface.

The result of all his observations on this subject, he has given in a series of 30 propositions, a few of which, on account of their importance, are here presented.

1. All the Infusoria are organized, the greater part, probably all, are highly organized animals.

2. The Infusoria form two natural classes of animals according to their structure, and may thus be scientifically classed, and admit no union of their forms with larger animals in corresponding species or families, however similar they may be in appearance.

3. The existence of Infusoria in four divisions of the globe, and also in the sea, is established, and particular species are similar in the most distant regions.

4. Since a cubic inch of earth often contains more than forty one thousand millions of single animals, the Infusoria form the greatest numerical proportion of individual life that is known, they constitute the principal number, perhaps the principal mass, of living animal organisms on the earth.

These labors of Professor Ehrenberg have led, as he informs us, to the establishment of two great principles, viz: That there is an animal organization, which does not proceed by gradation, but is perfect in all its principal parts; and next, that there is a great and direct influence of the world of microscopic forms on unorganized nature. The

consequence of the former, he adds, is a great, an *exceedingly great*, improbability of the existence of a spontaneous generation, or a motherless origin of organic bodies.

Ehrenberg's experiments in feeding the Infusoria with colored substances, such as carmine, indigo, &c., were generally successful; and as the transparency of their bodies enabled him to see this colored matter within them, and to trace its course, he considered it a satisfactory evidence of their internal organization, and founded upon it one of his two great divisions of the animalcular tribe, the *Polygastrica*, so called from the numerous cells within them, which he considered as stomachs. With one family, however, the Bacillaria, his attempts in this way were, at first, unavailing; and as this familiy was claimed by various botanists as a portion of the vegetable kingdom, or, at least, as a connecting link between that and the animal, he was the more desirous of finding some criterion by which their position might be more certainly determined. After a period of six years fruitless labor, as he tells us, he accomplished his object by a slight alteration in the manner of supplying them with this colored food, and saw the reception of it in seven species of Navicula, in Gomphonema paradoxum, and Arthrodesmus quadricaudatus and with Closterium acerosum, and he thus had the happiness to observe their internal organization, and also to establish incontestably, as he thinks, their claim to be ranked as animals.* It seems a little remarkable, that the botanical opponents of Ehrenberg, have omitted to notice this fact, on which he lays so great stress, and rest their opposition to his views, chiefly on the presence of starch, as indicated by the action of iodine on the bodies of some members of this family. The controversy is not yet closed; able writers and acute observers appear on both sides, and we can finish our observations no better than by saying, "Non nostrum inter *illos* tantas componere lites."

* Infusionsthierschen, pp. 87, 242.

Ehrenberg, in the progress of his observation of the Infusoria, gradually discovered the organs of mastication and deglutition, the alimentary canal, the apertures of the body, a muscular system, sexual organs, eyes, &c. It is not to be supposed that all these organs are to be found in every animalcule, nor is it probable that a common observer would perceive them in every case in which Ehrenberg has pointed them out. He possessed uncommon powers of observation, and united with them great ingenuity and skill in manipulation. He has been especially successful in drying and preserving the uncoated or illoricated infusoria, so as to exhibit not merely the outlines of their forms, but also the most delicate cilia which otherwise were hardly perceptible.

With the exception of Professor Bailey of West Point, who, since the year 1841, has made, in Silliman's Journal of Science, very ample and interesting communications respecting the American Bacillariæ, no one has given to the public any notice of the American Infusoria; it is to be hoped, therefore, that one who is so well qualified for the task, as Prof. B., both by his experience and habits of observation, will complete the work he has so successfully begun, and make the other portions of our infusorial tribes as well known to the naturalists of Europe, as he has already made the different members of the Bacillarian family.

To the members of the Essex Institute, whose activity and zeal are doing much for the advancement of natural science, it is hoped the following list of infusorial objects, found in and near Salem, Mass., however imperfect or incomplete, may not be altogether an unacceptable offering. It is placed at their disposal, in compliance with their request. It is the result of a series of observations commenced in the year 1835, and pursued as the occupation and amusement of leisure hours, without reference to any scientific purpose. As "Pritchard's Natural History of

Animalcules," was, for a long time, the only treatise on the subject, to which the observer had access, and that, however valuable, not affording sufficient means of identifying all the objects that were found, with forms previously known, much that was presented to view under the microscope, passed unrecorded, and only occasionally, as something of uncommon interest appeared, it was committed to paper. Subsequently, the acquisition of Ehrenberg's magnificent work on the Infusoria, afforded the means of comparing American forms with the figures given in that work, and such as could be identified with those figures, have been recorded; as for the rest, not having skill in the art of drawing, and aware of the difficulty of conveying accurate ideas of such objects by mere verbal descriptions, they have been reluctantly omitted.

In making the observations which have resulted in the following list, much valuable assistance has been afforded by Professor Bailey, not only in overcoming the difficulties incident to microscopical observations, but also for a large amount of interesting microscopic objects, the fruit of his own untiring investigations, or received from his foreign friends and correspondents, all of which he has most liberally imparted.

Ehrenberg divided the Infusoria into two classes, viz: the *Polygastrica*, and the *Rotatoria* (wheel-bearers,) so called from the action of cilia around the mouth, which resembles in their economy, the rotation of the spokes of a wheel.

POLYGASTRICA

Comprehends 22 Families, 123 Genera, 553 Species.

Fam. 1.	Monadina	Genera	9.	Species	26.
2.	Cryptomonadina	"	6.	"	16.
3.	Volvocina	"	10.	"	18.
4.	Vibriona	"	5.	"	14.
5.	Closterina	"	1.	"	16.

6.	Astasiaea	Genera	6.	species	24.
7.	Dinobryonia	"	2.	"	3.
8.	Amoebaea	"	1.	"	4.
9.	Arcellina	"	3.	"	9 to 10.
10.	Bacillaria	"	36.	"	168
11.	Cyclidina	"	3.	"	9.
12.	Peridinaea	"	4.	"	17.
13.	Vorticellina	"	8.	"	35.
14.	Ophrydina	"	4.	"	11.
15.	Enchelia	"	10.	"	30.
16.	Colepina	"	1.	"	57.
17.	Trachelina	"	8.	"	38.
18.	Ophryocercina	"	1.	"	3.
19.	Aspidiscina	"	1.	"	2.
20.	Kolpodea	"	5.	"	27.
21.	Oxytrichina	"	5.	"	17.
22.	Euplota	"	4.	"	12.

ROTATORIA

Comprehends 8 Families, 55 Genera, 169 Species.

Fam. 1.	Ichthydina	Genera	4.	Species	5.
2.	Oecistina	"	2.	"	2.
3.	Megalotrochaea	"	3.	"	3.
4.	Floscularia	"	6.	"	7.
5.	Hydatinaea	"	18.	"	71.
6.	Euclanidota	"	11.	"	36.
7.	Philodinaea	"	7.	"	18.
8.	Brachionaea	"	4.	"	27.

The following list of Infusoria, found in and near Salem, Mass., is arranged according to the system of Professor Ehrenberg.

POLYGASTRICA

3 Fam. Volvocina. 10 Genera, 18 Species.

Volvox sphaerosira	Ehr. Taf.	3.	Fig. 8.
glöbator		4.	1.
Pandorina morum		2.	33.
Synura uvella		3.	9.

5 Fam. Closterina. 1 Genus, 16 Species.

Closterium striolatum	Ehr. Taf.	6.	Fig. 12.
acerosum		6.	1.
rostratum		6.	10.
intermedium	Ralfs. Table	23.	4.
turgidum	Ehr. Taf.	6.	7.
costatum	Ralfs. Table	29.	1.
setaceum	Ehr. Taf.	6.	9.
trabecula		6.	2.
lunula		5.	15.
lineatum		6.	8.
cylindrus ?		6.	6.
Docidium nodosum ?	Ralfs.		
Spirotaenia condensata	Ralfs. Table	34.	Fig. 1.

6 Fam. Astasiaea. 6 Genera, 24 Species.

Amblyophis viridis	Ehr. Taf.	7.	Fig. 5.
Euglena acus		7.	15.
longicauda		7.	13.
pyrum		7.	11.
pleuronectes		7.	12.
triquetra		7.	14.
spirogyra ?		7.	10.
deses		7.	8.
Chlorogonium euchlorum		7.	17.
Distigma proteus		8.	4.

7 Fam. Dinobryonia. 2 Genera, 3 Species.

Dinobryon sertularia Ehr. Taf. 8. Fig. 8.

8 Fam. Amoebaea. 1 Genus, 4 Species.

Amoeba diffluens	Ehr. Taf.	8. Fig.	12.
radiosa		8.	13.

9 Fam. Arcellina. 3 Genera, 7 Species 9—10.

Arcella vulgaris	Ehr. Taf.	9. Fig.	5.
Difflugia proteiformis		9.	1.
acuminata		9.	3.

10 Fam. Bacillaria. 36 Genera, 168 Species.

Desmidium Swartzii	Ehr. Taf.	10. Fig.	8.
aculeatum		10.	12.
Staurastrum dilatatum		10.	13.
gracile	Ralfs		
Xanthidium furcatum	Ehr. Taf.	10.	25.
aculeatum		10.	23.
hirsutum		10.	22.
fasciculatum		10.	24.
Arthrodesmus convergens		10.	18.
quadricaudatus		10.	16.
Odontella desmidium		16.	4.
Tessararthra filiformis		10.	21.
Pentasterias margaritacea		10.	15.
Micrasterias heptactis		11.	4.
hexactis		11.	3.
fimbriata	Ralfs		
Boryana	Ehr. Taf.	11.	5.
furcata	Ralfs		
tricyclia	Ehr. Taf.	11.	8.
Euastrum rota		12.	1.
crux melitensis		12.	3.
verrucosum		12.	5.
pecten		12.	4.
margaritiferum		12.	7.
Cosmarium ovale	Ralfs		
Gallionella moniliformis	Ehr. Taf.	10.	5.
Navicula striatula		21.	15.

Navicula, viridis	Ehr. Taf.	13. Fig.	16.
baltica		13.	10.
sigma		13.	12.
angulata	Quekett on Mic.		
interrupta. Kutzing.			
sp. unknown			
lanceolata	Ehr. Taf.	13. Fig.	21.
Eunotia tetraodon		21.	25.
pentodon		21.	26.
serra		21.	28.
Cocconeis scutellum		14.	8.
Fragilaria grandis		15.	11.
rhabdosoma		15.	12.
Bacillaria elongata		15.	5.
tabellaris		15.	7.
Synedra ulna		17.	1.
lunaris		17.	4.
capitata		21.	29.
Podosphenia gracilis		17.	6.
Gomphonema acuminatum		18.	4.
Cocconema cistula		19.	7.
Naunema simplex		20.	12.

11 Fam. Cyclidina. 3 Genera, 9 Species.

Cyclidium glaucoma	Ehr. Taf.	22. Fig.	1.

12 Fam. Peridinaea. 4 Genera, 17 Species.

Peridinium fuscum	Ehr. Taf.	22. Fig.	15.
Glenodinium apiculatum		22.	24.

13 Fam. Vorticellina. 8 Genera, 35 Species.

Stentor Mulleri	Ehr. Taf.	23. Fig.	1.
Vorticella nebulifera		25.	1.
campanula		25.	4.
convallaria		26.	3.

Carchesium polypinum	Ehr. Taf.	26.	Fig. 5.
Epistylis galea		27.	1.
anastatica		27.	2.
nutans		29.	1.
Urocentrum turbo		24.	7.

14 Fam. Ophrydina. 4 Genera, 11 Species.

Cothurnia imberbis	Ehr. Taf.	30.	Fig. 7.
Vaginicola tincta		30.	5.

15 Fam. Enchelia. 10 Genera, 30 Species.

Actinophris sol	Ehr. Taf.	31.	Fig. 6.
viridis		31.	7.
Lacrymaria proteus		31.	17.

16 Fam. Colepina. 1 Genus, 5 Species.

Coleps hirtus	Ehr. Taf.	33.	Fig. 1.

17 Fam. Trachelina. 8 Genera, 38 Species.

Trachelius anas	Ehr. Taf.	33.	Fig. 6.
meleagris		33.	8.
tricophorus		33.	11.
ovum		33.	13.
Spirostomum ambiguum		36.	2
Chilodon cucullus		36.	7.

18 Fam. Ophryocercina. 1 Genus, 3 Species.

Trachelo-cerca olor	Ehr. Taf.	38.	Fig. 7.

20 Fam. Kolpodea. 5 Genera, 27 Species.

Amphileptus margaritifer	Ehr. Taf.	37.	Fig. 5.
Paramecium aurelia		39.	6.
Uroleptus filum		40.	5.
piscis		40.	1.

21 Fam. Oxytrichina. 5 Genera, 17 Species.

Oxytricha caudata	Ehr. Taf.	40.	Fig. 11.

Urostyla grandis	Ehr. Taf. 41.	Fig. 8.
Stylonichia mytilus	41.	9.

22 Fam. Euplota. 4 Genera, 12 Species.

Euplotes patella	Ehr. Taf. 42.	Fig. 9.
charon	42.	10.

ROTATORIA.

1 Fam. Ichthydina. 4 Genera, 6 Species.

Chaetonotus maximus	Ehr. Taf. 43.	Fig. 3.
larus	43.	4.

4 Fam. Floscularia. 6 Genera, 7 Species.

Floscularia proboscidea	Ehr. Taf. 46.	Fig. 1.
ornata	46.	2.
Melicerta ringens	46.	3.

5 Fam. Hydatinaea. 18 Genera, 71 Species.

Notommata longiseta	Ehr. Taf. 53.	Fig. 2.
copeus	51.	1.
Scaridium longicaudum	54.	1.

6 Fam. Euchlanidota. 11 Genera, 36 Species.

Lepadella emarginata	Ehr. Taf. 57.	Fig. 2.
Dinocharis pocillum	59.	1.
Stephanops lamellaris	59.	13.
Euchlanis triquetra	57.	8.

7 Fam. Philodinaea. 7 Genera, 18 Species.

Rotifer vulgaris	Ehr. Taf. 60.	Fig. 4.
Philodina aculeata	61.	9.

8 Fam. Brachionaea. 4 Genera, 27 Species.

Brachionus brevispinus	Ehr. Taf. 63.	Fig. 6.
Bakeri	64.	1.